

Electronic force sensing with sensor normalization

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Abstract

Methods and apparatus are disclosed for normalizing electronic sensor data to correct for variations in individual sensor transfer characteristics which are not known in advance. A general characteristic transfer function for a sensor type of interest is determined empirically. A baseline response reading is acquired from an individual sensor, and that baseline response applied to the general transfer function to determine a specific transfer function for the individual sensor. The specific transfer function is used to calculate normalized data. One application of the invention is in computer cursor control pointing devices such as a joystick. Because the invention compensates for wide variations in sensor characteristics, inexpensive sensors such as force-sensitive resistors may be used in a joystick without sacrificing pointing accuracy and ergonomic efficiency.

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United States Patent [19][11] **Patent Number:** 5,440,237**Brown et al.**[45] **Date of Patent:** Aug. 8, 1995[54] **ELECTRONIC FORCE SENSING WITH
SENSOR NORMALIZATION**[75] **Inventors:** Daniel R. Brown, Beaver Creek;
Philip D. Biehl, Tigard, both of Oreg.[73] **Assignee:** InControl Solutions, Inc., Clackamas,
Oreg.[21] **Appl. No.:** 69,717[22] **Filed:** Jun. 1, 1993[51] **Int. Cl.⁶** G04F 10/00; G01L 7/04[52] **U.S. Cl.** 324/601; 324/130;
364/571.01[58] **Field of Search** 324/115, 73.1, 132,
324/74, 130, 601; 345/159, 161;
364/571.01-571.08[56] **References Cited****U.S. PATENT DOCUMENTS**

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& Stelowitz[57] **ABSTRACT**

Methods and apparatus are disclosed for normalizing electronic sensor data to correct for variations in individual sensor transfer characteristics which are not known in advance. A general characteristic transfer function for a sensor type of interest is determined empirically. A baseline response reading is acquired from an individual sensor, and that baseline response applied to the general transfer function to determine a specific transfer function for the individual sensor. The specific transfer function is used to calculate normalized data. One application of the invention is in computer cursor control pointing devices such as a joystick. Because the invention compensates for wide variations in sensor characteristics, inexpensive sensors such as force-sensitive resistors may be used in a joystick without sacrificing pointing accuracy and ergonomic efficiency.

13 Claims, 8 Drawing Sheets